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T H E

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THE CURIOUS HISTORY OF A BUTTERFLY.

BY SAMUEL H. SCUDDER.



OF all American butterflies *Brenthis Bellona* presents the strangest history. Everybody knows that butterflies pass through several stages of growth, from the egg, caterpillar and chrysalis to the butterfly—a cycle of changes which succeed each other with perfect uniformity from year to year; it is also known to most who read these pages that many butterflies pass through this cycle twice or even thrice in the course of the year, while others again are “single-brooded.” If one should assert that *Brenthis Bellona* was single-brooded, most, if not all, observers would say it was an error; do not butterflies of this species, fresh from the chrysalis, appear late in May, again in July and still, once more, in September?—true, and yet, properly speaking, the insect *is* single-brooded.

In this genus—at least in *B. Bellona* and *B. Myrina*—occurs a phenomenon, which, so far as I know, is quite unique among butterflies; there are two sets of individuals, each following its own cycle of changes, apparently with as little to do with the other set as if it were a different species; each set has its own distinct seasons and thus gives rise to the apparition of two or three successive “broods” in the course of the year.

At the very end of the season this butterfly will be found laying eggs, which hatch in a few days; the little caterpillars, after

devouring their egg-shells, refuse further food and undoubtedly hibernate in this state—which is nearly equivalent to remaining in the egg; for eggs of Lepidoptera may be found in midwinter, in nearly all stages of development, according to the species. These juvenile larvæ represent the hiemal condition of one of the two sets of individuals above mentioned; this we will term the æstival series; for by the end of the following June, the caterpillars have attained their growth and, passing through the chrysalis state, emerge as butterflies about the middle of July; these are the butterflies of midsummer, continuing upon the wing until the end of September. In this butterfly, the eggs are wholly undeveloped at the birth of the female, and in the æstival series are not deposited until September; they hatch in from five to nine days and the young caterpillars, as we have said, pass directly into a state of hibernation, making the cycle of the year's changes complete with a single generation. This history is quite similar to that of the New England species of *Argynnis*, all of which are single-brooded, appear in early summer, lay their eggs in early autumn and hibernate as juvenile larvæ; but these have not super-added the second series of individuals which form so striking a feature in the natural history of some of our native species of *Brenthis*.

This second set of individuals, which we will term the vernal, in contrast to the æstival series, hibernates as *half-grown* caterpillars and produces the earliest brood of butterflies; these make their appearance about the middle of May, although they are occasionally seen earlier; they are hardly common before the end of the month and are as long-lived as their companions of the æstival series; they do not lay their eggs until the latter part of July and early in August—just when the butterflies of the æstival series are becoming common; the eggs hatch and the caterpillars grow as usual for a few weeks, sloughing their integuments twice; beyond this point all the caterpillars do not develop alike; some continue in what would appear the natural way; we will first follow them—it will be to their grave! As caterpillars they eat, as chrysalides they sleep and then appear in September, gay and frolicsome butterflies—doomed to an untimely end. Their sisters of the æstival series are busily laying eggs to perpetuate the race,*

* For the phenomenon of midsummer is now repeated inversely, one series ovipositing, the other emerging from the chrysalis.

but to them is this boon denied ; the cold autumnal blasts sweep them away before the eggs are half developed in their ovaries. It is, in fact, a vain effort of Nature to develop a second brood which, in a more southern climate, with a longer season, would prove successful.

But we have said that this was the history of some only ; and this fact proves the salvation of the vernal series ; when about half grown, in the middle of August, while the weather is still hot, a portion of the caterpillars suddenly cease to eat and fall into a state of lethargy. Something similar to this, if we may trust the observations of Vandouer, as related by Doubleday, has been noticed in a European species of this genus, but earlier in the season, when it would seem to be more unaccountable, because, so far as we can see, less necessary. "Having succeeded," says W. Doubleday, "in obtaining some eggs of this species (*B. Euphrosyne*), which were laid about the middle of May, I fed the young larvæ produced from them until the end of June, when they all fell into a state of complete torpidity, in which most of them remained until the following spring. But in August a portion of them woke from their sleep, fed with voracity, changed their skins twice, became pupæ and in a few days perfect insects. It was only at the end of the following February that the others commenced feeding, changed their skins twice and after the first week in April became pupæ, from which the perfect insects appeared at the usual time." By this account, the butterflies lay their eggs on their first appearance ; either they differ *in toto* from their congeners in America or there is some error in this statement. The state of lethargy into which our August caterpillars sometimes fall may perhaps be better denominated premature hibernation, for they do not arouse themselves until the following spring, when they again resume the cycle of changes peculiar to the vernal series, and by this extraordinary habit preserve its history.

Here we have two independent series in the same species, each single-brooded, but one making an effort toward a second generation, invariably ending in disaster ; the butterfly may therefore be properly considered as "single-brooded," although differing greatly from other single-brooded butterflies, by presenting three distinct apparitions of the perfect form. Whether, by any lethargic freaks, the caterpillars of the two series even unite their faces and finally have a synchronous and parallel development, we are

as yet unprepared to say ; but that the blood of both series ever commingles, through the union of the perfect insect, is very improbable because, although the generations overlap, the males of a brood are the first to disappear and the females the last to appear, and at best there would be few that could thus mate ; moreover, since the eggs of the freshly enclosed females are not fully developed for weeks, or even months, the effect of such a union would be questionable. Yet, if there is no union between the two series, there are the vernal and æstival groups practically as distinct from each other as any two species ! Nature strives toward the formation of a double brood in the vernal series ; may we not suggest that she has already made considerable progress toward the development of a new species, in producing the vernal series at all ? Pass in review the histories of different species of the same genus or even allied genera of butterflies, and you will find in them a remarkable similarity—trace of a law of unity in habits and seasons as pronounced as that of unity in coloration and structure, extending not only to the number of broods, but also to their seasons. In the æstival series of *Brenthis* we find indeed something very similar to what occurs in *Argynnis*, and this must therefore be considered the normal series ; but, in addition, we have a second set of individuals maintaining a totally distinct season, by other means (lethargy or premature hibernation), passing the winter in a different condition, and even attempting an additional generation—showing a difference such as usually characterizes somewhat distant genera. Will not Messrs. Cope and Hyatt claim this as a new argument in favor of their theories of the origin of species ?

Whether any colorational or structural features distinguish the butterflies of the vernal from those of the æstival series, I am unable to say and must leave to those who can follow the insect in the field ; it is a question worthy of investigation, since the spring and autumn broods of butterflies often present differences so well marked that the broods have been described as distinct species.

Some one will ask whether these different apparitions of the butterfly cannot be accounted for on the supposition of a *single* series of individuals, with lethargy on the part of the caterpillar, as in the case of the European *Euphrosyne*. Plainly not ; for we have in our butterfly three apparitions instead of two, and two

depositions of eggs in place of one ; moreover, the fact is sufficiently established, that some of the caterpillars of the vernal series hibernate when half grown, after a period of lethargy and that the æstival series can only pass the winter as caterpillars just from the egg ; so too is the period of oviposition ; these facts being granted, and the apparition of the butterflies known to all observers as occurring at the times stated, any other interpretation seems impossible.

In all plural-brooded butterflies, with an extensive distribution in latitude, the number of generations varies with the length of the season. I am not aware that the mode of this variation has ever been studied ; are the changes sudden or gradual ? and do they involve any waste of energy on the part of Nature, as in *Brenthis Bellona* ? A little consideration will show what the result would be in the species under discussion ; should the season be so long that the second brood of the vernal series could lay eggs, these eggs would at once hatch, for their normal period being often as short as five days, weather which could induce a butterfly to lay eggs would at once ripen the embryo ; the caterpillars would then be forced to hibernate as those of the æstival series and become members of that series the next year ; while the vernal series would be kept up by means of those caterpillars of its first brood which, in the previous year, had gone into premature hibernation. Thus the vernal series would continually feed the æstival ; yet it would suffer no greater loss than it does at present in the practical sterility of the September butterflies ; it would be subjected to no infusion of blood from the æstival series and any variation of structure from the normal type of the species, induced by its isolation, would not be lost. Were the season still longer, the vernal series would become double-brooded and independent, the caterpillars having time to attain half their size before hibernation ; the lethargic propensity would be retained only by the æstival series, which, by this time, would probably have assumed the position our vernal series occupied at the beginning.

If, on the other hand, we suppose a shorter season, such as actually exists in some parts of the country where *Brenthis Bellona* occurs, undoubtedly the first change would be the entire elimination of the September butterflies and the hibernation of all the vernal caterpillars when half grown ; this is probably the actual state of things in the cooler parts of Canada ; but what would be

the further backward steps toward the simple condition of Argynnis—that is, toward the extinction of the vernal series—it would be hard to conjecture, without treading on insecure ground; rather let us leave that to the future development of parallel facts. —*Menton, France, April, 1872.*

ON THE GEOLOGY OF THE ISLAND OF AQUIDNECK AND THE NEIGHBORING PARTS OF THE SHORES OF NARRAGANSET BAY.*

BY PROF. N. S. SHALER.

GENERAL TOPOGRAPHY.—The contour of the shore at this point of our coast at once indicates some peculiar features in the history of the rock masses in which it lies. A great indentation of the coast line having a width of twelve and a depth of over twenty miles, cut here and there with narrow islands and running up into the land in long river-like arms for many miles beyond the limits of its main area, Narraganset Bay, leads us to seek for some forces operating in its formation which were not at work, at least with the same energy, in the region of shore more to the southward and westward. A glance at the general topography will show us more clearly what is to be regarded as peculiar and requiring an explanation from the ancient history of this region.

Nearly the whole of the excavation of Narraganset Bay lies in a region commonly known as Carboniferous.† The great excavations of the Chesapeake and Delaware lie altogether in a region of soft, easily disintegrated material and are thus not comparable with what we have here. The valleys of the Connecticut, the Hudson and the Thames, nearer to the region we are studying, are in the same sort of rocks, or those of nearer equivalent hardness, and are therefore more likely to give us a measure for the forces acting here. But we find that these latter

* This and the papers to be hereafter published in the same series, are extracts from a Report to Prof. Benj. Pierce, Superintendent of the United States Coast Survey, and are made public by his permission.

† It will hereafter be shown that a very large part of this region generally mapped as carboniferous is in all probability of a very much earlier age. The evidence goes to show that it is a member of the Cambrian series.